Amendments to Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended) A barrier stack comprising:

a first sub-barrier layer, the first sub-barrier layer comprises a first sub-barrier conductive barrier material, the first sub-barrier layer includes grain boundaries ~~layer; and~~

a second sub-barrier layer disposed above the first sub-barrier layer, the second sub-barrier layer comprises a second sub-barrier conductive barrier material, the second sub-barrier layer includes grain boundaries; and

passivating elements are provided to passivate grain boundaries on an upper surface of the first sub-barrier layer ~~a second barrier layer above the first barrier layer, the second barrier layer comprises a conductive oxide to enhance the barrier properties of the barrier stack~~.

2. (original) The barrier stack of claim 1 serves as a barrier for capacitor over plug structure of a memory cell.

3. (original) The barrier stack of claim 2 wherein the capacitor over plug structure includes a plug having a step over an ILD layer.

4. (currently amended) The barrier stack of claim ~~2~~ 1 serves as a barrier for capacitor over plug structure of ~~further comprises~~ a plurality of memory cells arranged in a series architecture.

5. (original) The barrier stack of claim 4 wherein the capacitor over plug structure includes a plug having a step over an ILD layer.

6. (original) The barrier stack of claim 1 serves as a barrier for capacitor over plug structure of a ferroelectric memory cell.

7. (original) The barrier stack of claim 6 wherein the capacitor over plug structure includes a plug having a step over an ILD layer.

8. (currently amended) The barrier stack of claim ~~6~~ 1 serves as a barrier for capacitor over plug structure of ~~further comprises~~ a plurality of ferroelectric memory cells arranged in a series architecture.

9. (original) The barrier stack of claim 8 wherein the capacitor over plug structure includes a plug having a step over an ILD layer.

10. (cancelled)

11. (cancelled)

12. (cancelled)

13. (cancelled)

14. (cancelled)

15. (cancelled)

16. (cancelled)

17. (cancelled)

18. (currently amended) The barrier stack of claim 1 wherein ~~an RTO is performed after the first barrier layer is formed and before the second barrier layer is formed~~ the passivating elements comprises oxygen .

19. (currently amended) The barrier stack of claim 18 wherein:

the first sub-barrier material ~~barrier layers~~ comprises Ir, Ru, Rh, Pd, Hf or a combination thereof; and

the second sub-barrier material comprises Ir, Ru, Rh, Pd, Hf, a conductive oxide or a combination thereof.

20. (currently amended) The barrier stack of claim 19 wherein the ~~second barrier layer comprises oxides of Ir, Ru, Rh, Pd, Hf or a combination thereof~~ grain boundaries of the first and second sub-barrier layers are mismatched.

21. (currently amended) The barrier stack of claim ~~18~~ 19 wherein the ~~second barrier layer comprises oxides of Ir, Ru, Rh, Pd, Hf or a combination thereof~~ grain boundaries of the first and second sub-barrier layers are mismatched.

22. (cancelled)

23. (new) The barrier stack of claim 1 wherein:

the first sub-barrier material comprises Ir, Ru, Rh, Pd, Hf or a combination thereof; and

the second sub-barrier material comprises Ir, Ru, Rh, Pd, Hf, a conductive oxide or a combination thereof.

24. (new) The barrier stack of claim 23 wherein the grain boundaries of the first and second sub-barrier layers are mismatched.

25. (new) The barrier stack of claim 1 wherein the grain boundaries of the first and second sub-barrier layers are mismatched.

26. (new) The barrier stack of claim 23 wherein the passivating elements comprises a size greater than the grain boundaries of the first sub-barrier layer.

27. (new) The barrier stack of claim 26 wherein:

the first sub-barrier material comprises Ir, Ru, Rh, Pd, Hf or a combination thereof; and

the second sub-barrier material comprises Ir, Ru, Rh, Pd, Hf, a conductive oxide or a combination thereof.

28. (new) The barrier stack of claim 27 wherein the grain boundaries of the first and second sub-barrier layers are mismatched.

29. (new) The barrier stack of claim 26 wherein the grain boundaries of the first and second sub-barrier layers are mismatched.

30. (new) The barrier stack of claim 1 further comprises an upper barrier layer disposed above the second sub-barrier layer, the upper barrier layer comprises a conductive oxide.

31 (new) The barrier stack of claim 30 wherein the passivating elements comprises a size greater than the grain boundaries of the first sub-barrier layer.

32. (new) The barrier stack of claim 30 wherein the passivating elements comprises oxygen.

33. (new) The barrier stack of claim 30 wherein:

the first sub-barrier material comprises Ir, Ru, Rh, Pd, Hf or a combination thereof; and

the second sub-barrier material comprises Ir, Ru, Rh, Pd, Hf, a conductive oxide or a combination thereof.

34. (new) The barrier stack of claim 30 wherein the grain boundaries of the first and second sub-barrier layers are mismatched.

35. (new) The barrier stack of claim 30 wherein the grain boundaries of the upper barrier and second sub-barrier layers are mismatched.

36. (new) A barrier stack comprising:

a first sub-barrier layer, the first sub-barrier layer comprises a first sub-barrier conductive barrier material, the first sub-barrier layer includes grain boundaries;

a second sub-barrier layer disposed above the first sub-barrier layer, the second sub-barrier layer comprises a second sub-barrier conductive barrier material, the second sub-barrier layer includes grain boundaries; and

passivating elements are provided to passivate grain boundaries on an upper surface of the first sub-barrier layer, wherein the passivating elements comprises a size greater than the grain boundaries of the first sub-barrier layer.

37. (new) A barrier stack comprising:

a first sub-barrier layer, the first sub-barrier layer comprises a first sub-barrier conductive barrier material, the first sub-barrier layer includes grain boundaries;

a second sub-barrier layer disposed above the first sub-barrier layer, the second sub-barrier layer comprises a second sub-barrier conductive barrier material, the second sub-barrier layer includes grain boundaries;

wherein grain boundaries of the first and second sub-barrier layers are mismatched; and

passivating elements are provided to passivate grain boundaries on an upper surface of the first sub-barrier layer.